PEBB-Based Converter

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- SPCO PEBB Activities
- NMCT-based PEBB brassboard demonstration
  - Project Goals
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Components

- MOS Turn Off Thyristor (MTO)
- Silicon Carbide MTO
- Gate Assisted Turn Off Thyristor (GATT)
- Advanced GTO

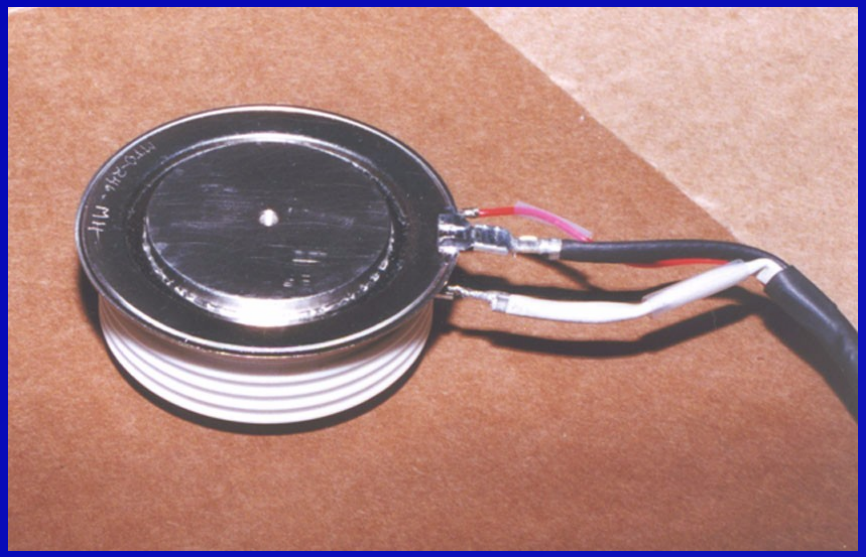
Packaging/ Accessories

- Structured Copper
- Light Weight Package
- Gate Drive Modules (MTO, GTO, GATT)
- Separately Light Triggered Thyristor (SLTT)

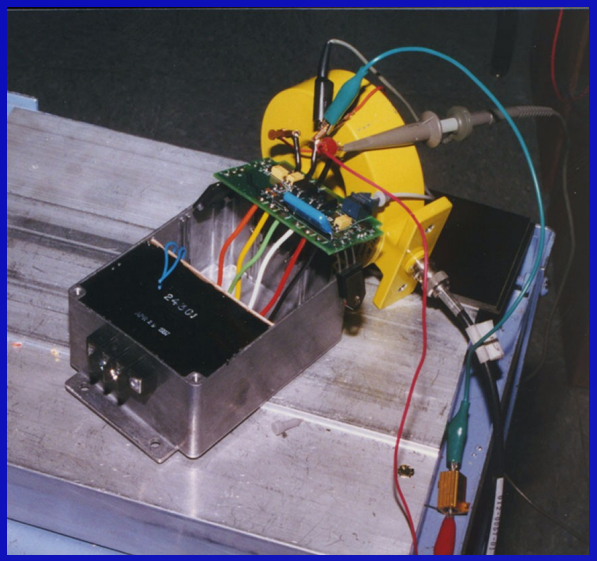
System/ Sub-system Development

- Static Transfer Switch
- PEBB Inverter
- SSIM Inverter
- STATCON/ UPS
- Static Voltage Regulator

MTO Status



53mm MTOs

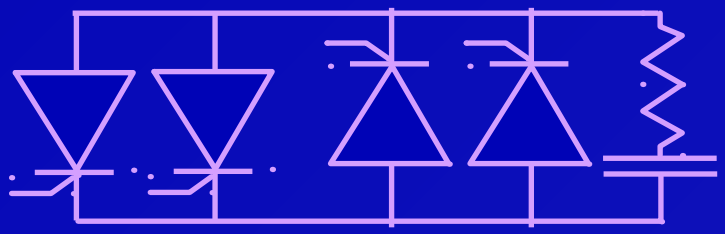


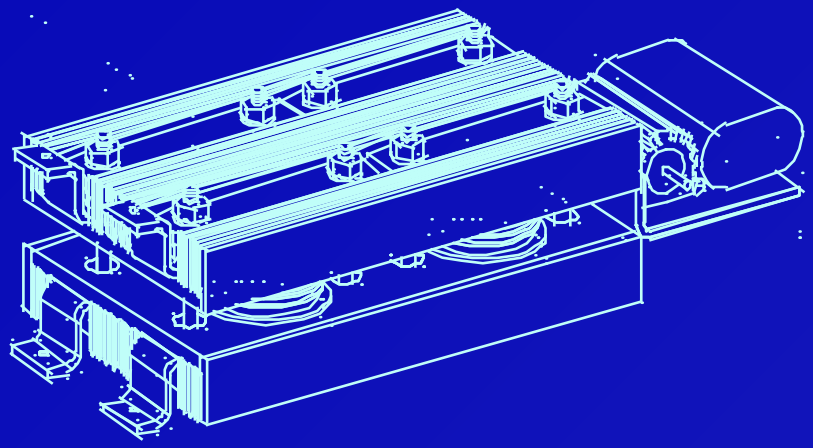
MTO gate drivers

4.5 kV MTOs (17) and gate drivers (27) delivered to ONR on April 30th, 97

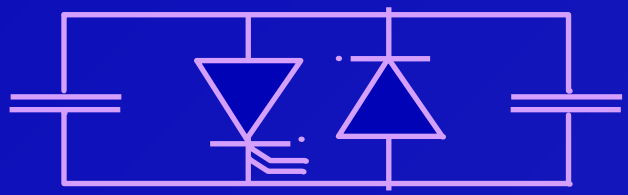
SPCO HPEBB modules

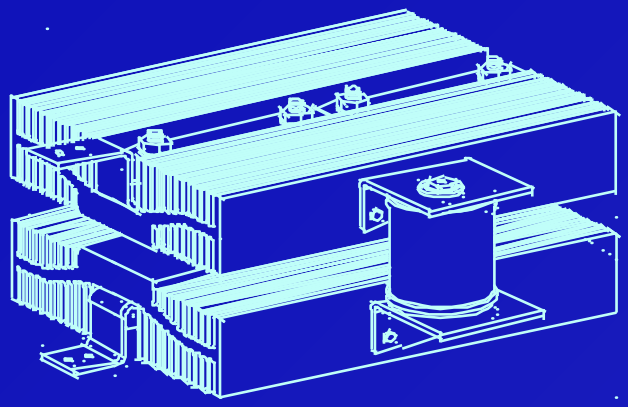
AC switch



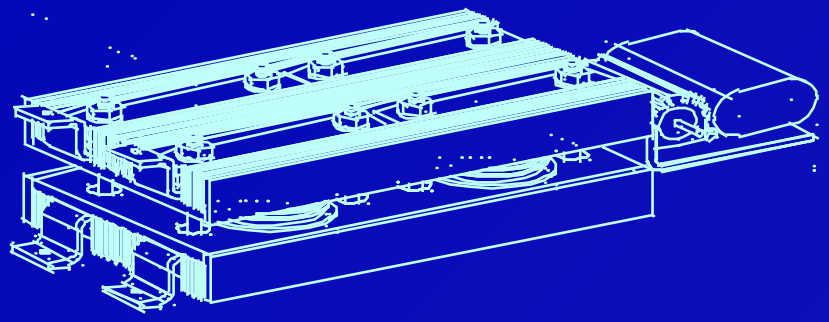


Inverter switch





SPCO HPEBB Applications

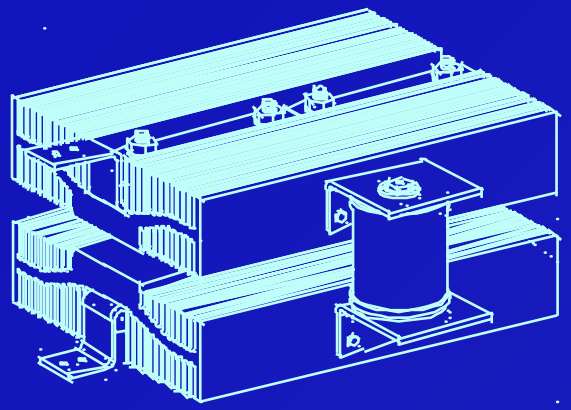


300 - 600 - 1,200 A switches
480 V - 38 kVac

0.5 - 6 MVA Inverter
480 - 15 kVac
1.0 - 4.0 kHz

STATCON/UPS Inverter
Propulsion Motor Module
Active filter
DVR

Medium Voltage Transfer Switch
Static Voltage Regulator
Static Phase Shifter
Solid State Breaker
Fault Current Limiter



SPCO PEBB Converter - Project Goals

- Externally funded effort: contract between SPCO and Lockheed Martin under Navy TI005
- Design and manufacture of two voltage source power converter units using PEBB-1 N-MCTs
- 6 soft-switched ARCP phase legs per converter
- 50 kW output power per unit

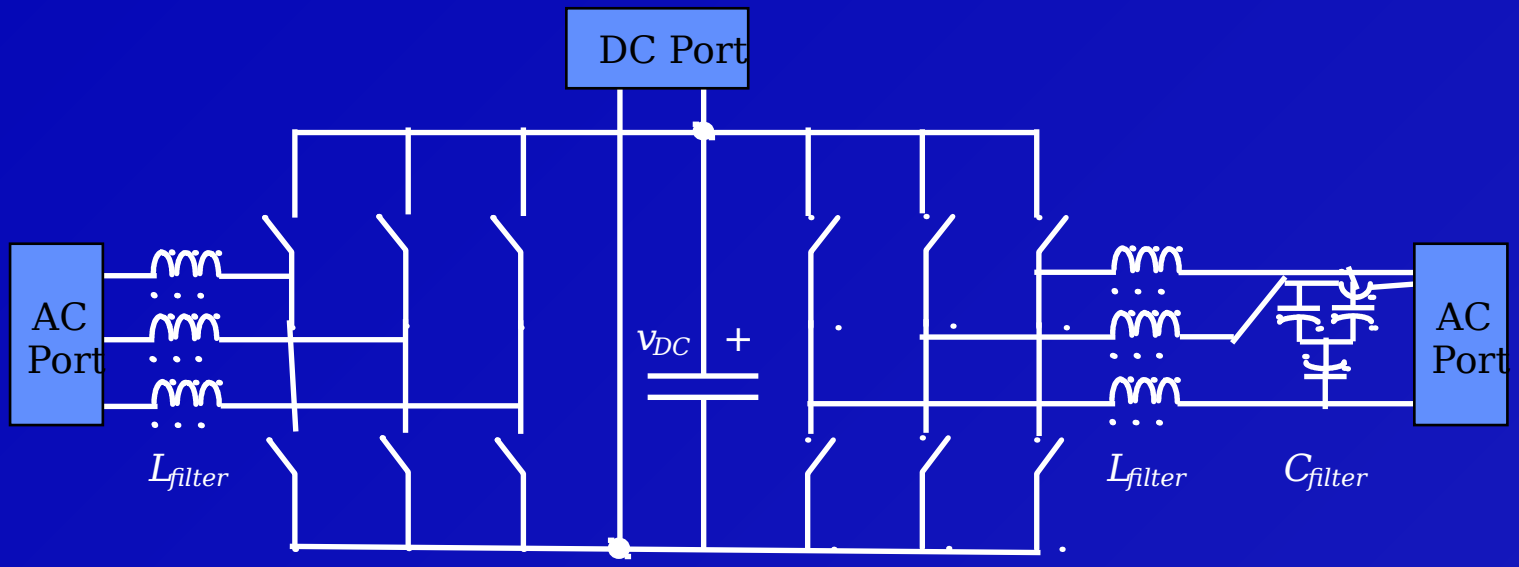
he main goal of the PEBB-based Converter Project is t
demonstrate N-MCT devices in a practical application

System Requirements

Single Phase H-Bridge Inverter 270 V_{dc} -> 120 V_{ac} @ 60 Hz 750 V_{dc} -> 450 V_{ac} @ 60 Hz	Three Phase Bridge Rectifier 450 V_{ac} @ 60 Hz -> 750 V_{dc} 450 V_{ac} @ 400 Hz -> 750 V_{dc}
Three Phase Inverter 750 V_{dc} -> 450 V_{ac} @ 60 Hz 750 V_{dc} -> 450 V_{ac} @ 400 Hz	Three Phase Frequency Changer 450 V_{ac} @ 60Hz -> 450 V_{ac} @ 400Hz
DC-DC Converter 750 V_{dc} -> 155 V_{dc} 750 V_{dc} -> 270 V_{dc}	Switching Frequency minimum of 20 kHz target: 75 to 100 kHz

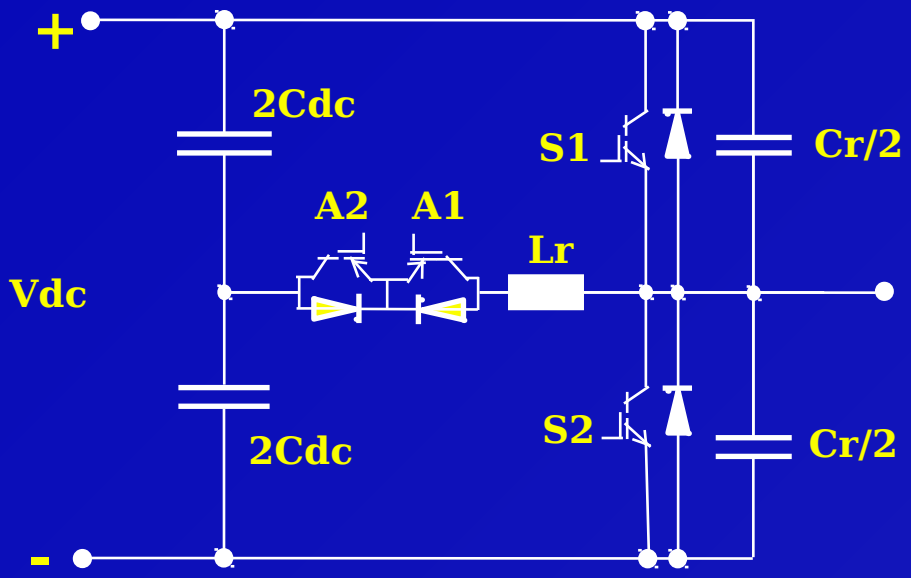
The primary challenges:
- reconfigurability for different functions
- control algorithm execution within switching

PEBB-Based Power Circuit

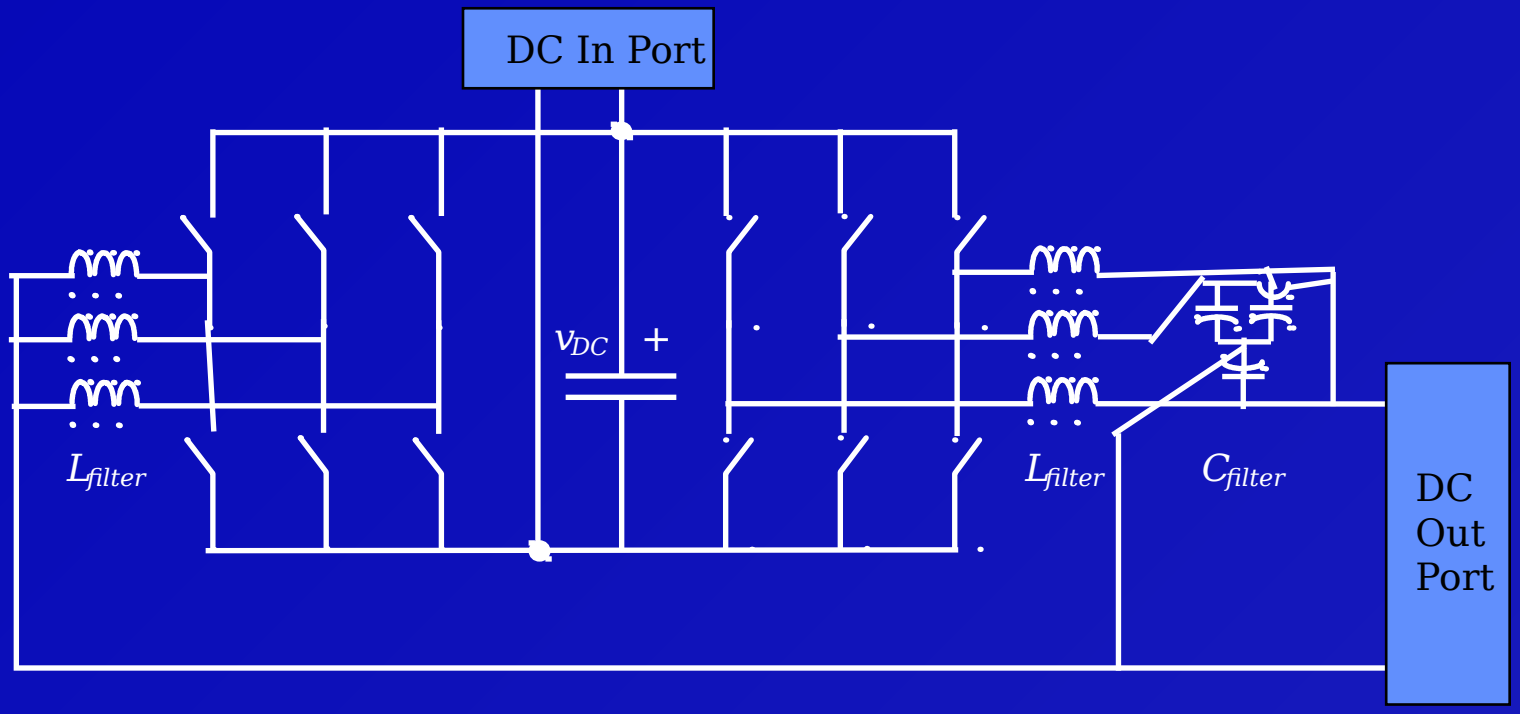


The six phase-leg converter power circuit (excludes protective / pre-charging and reconfiguration circuits).

ARCP Phase Leg



Reconfigured as DC/DC Converter



H-bridge connection using all the six phase legs.

Controls Implementation

Hardware

- AD21062 DSP - main processor
- FPGAs - PWM and soft-switching logic

Software

- Assembly - interrupt-driven control algorithm
- C - user-driven configuration / communication algorithm

Controls Task Distribution

Interrupt-driven Process

-> read samples

-> calculate control:

. predictor algorithm

. reference current calculation

. control calculation

. PWM algorithm

-> write controls to FPGA

User-driven Process

-> local user interface

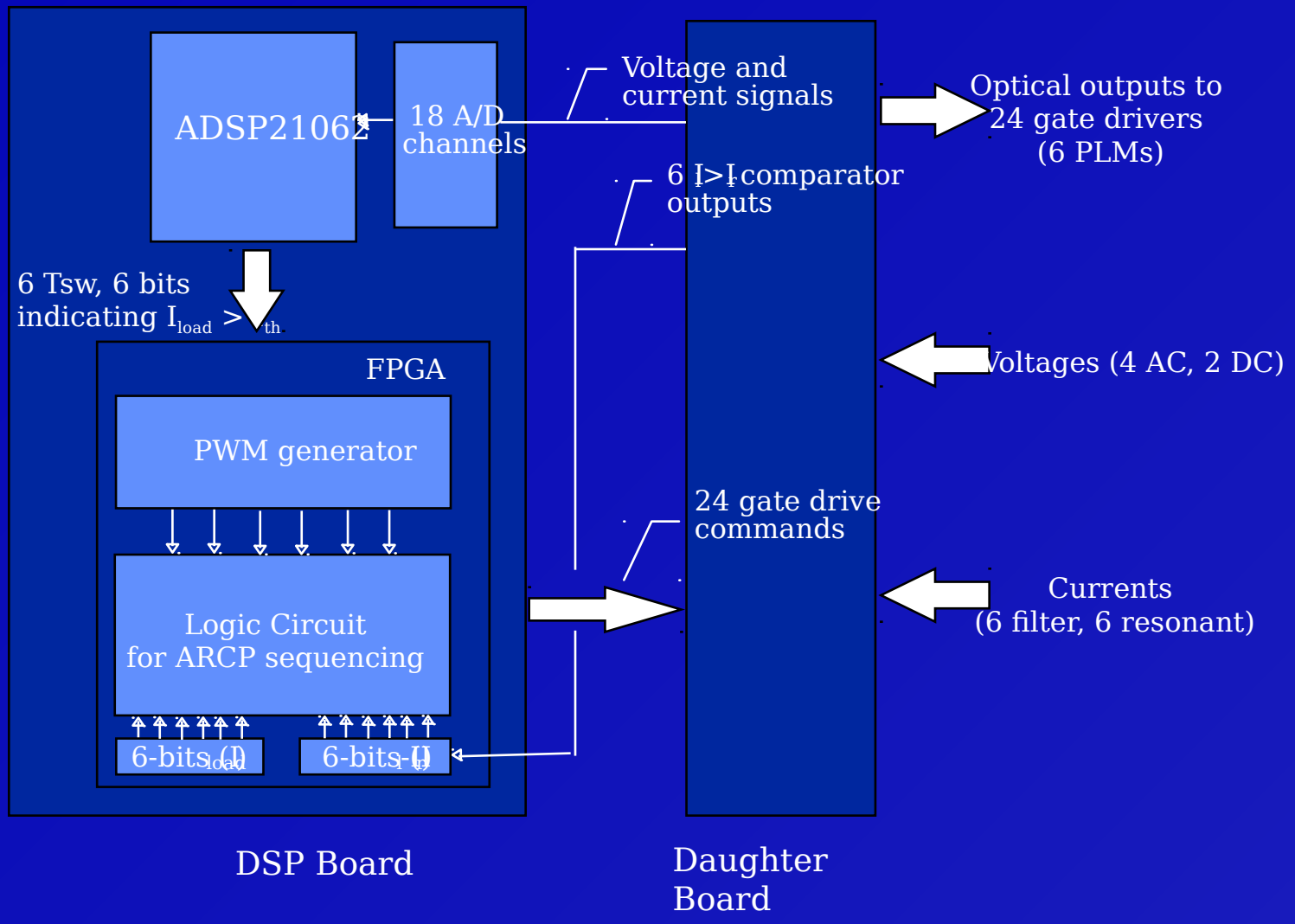
-> remote communications

-> system diagnostics

-> triggering of interrupt-driven process

-> system initialization and re-configuration

Converter Control Schematic



Project Status

Power Circuit

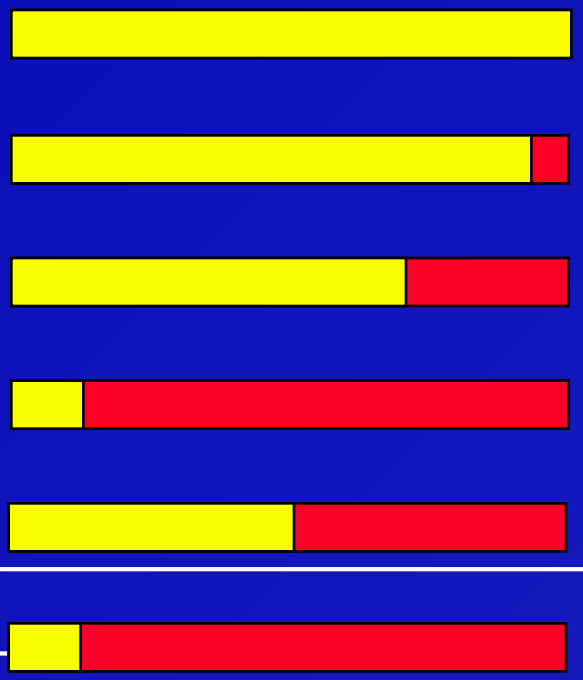
Control Hardware

Control Software

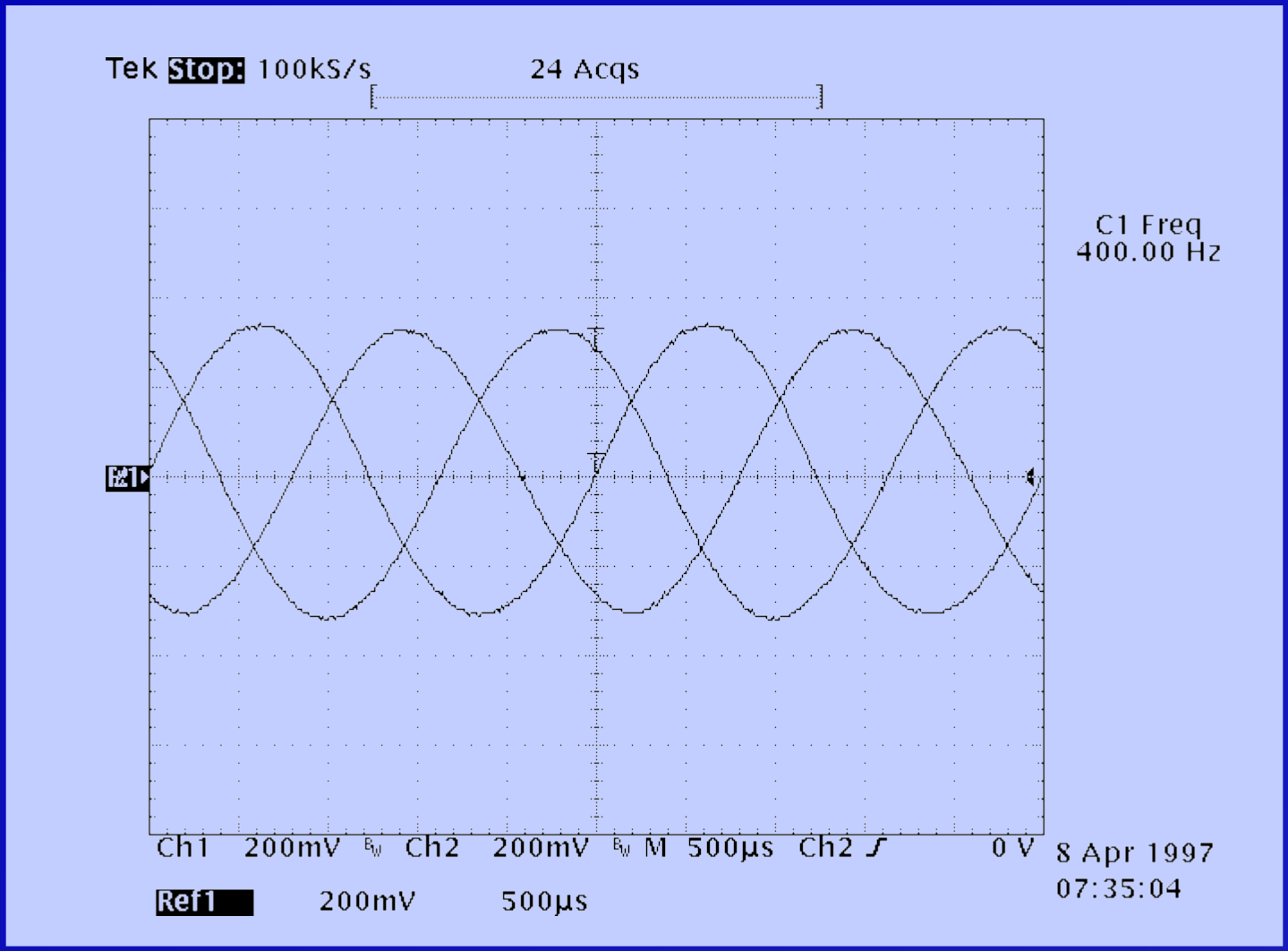
Communication

Assembly

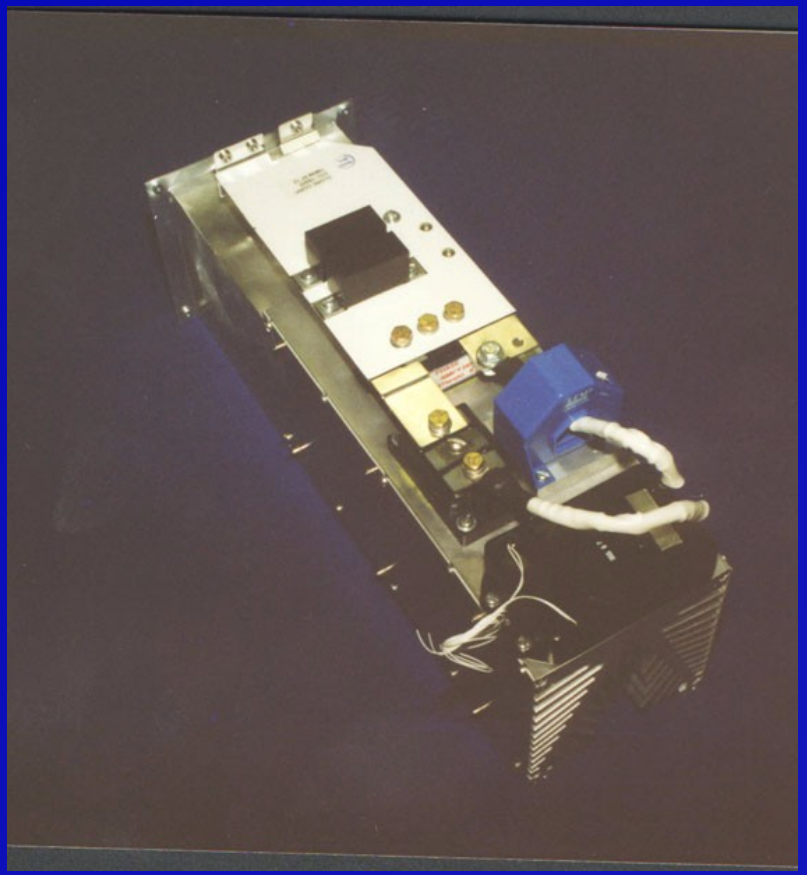
Testing



Hard-Switched Test Setup Results



Phase Leg Module



Converter Cabinet

Thank you!